

Measuring Sprawl

*Widely decried, sprawl is
difficult to define and even
more difficult to measure.*

ONE OF THE earliest uses of the term “sprawl” was in a 1974 study, commissioned by the U.S. Department of Housing and Urban Development. The report, which compared the economic consequences of high- and low-density suburban development, was titled *The Costs of Sprawl*; opponents of low-density development realized early that they could occupy the high ground by defining the language of the debate. Some years later, something similar happened when the term “smart growth” was coined — after all, who would want to champion dumb growth?

Sprawl is generally associated with low-density development and a number of

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related conditions: a reliance on private automobiles rather than mass transit; poor accessibility between related uses; continuous retail development rather than definite town centers; and scattered development rather than compact, contiguous neighborhoods. According to Andres Duany and Elizabeth Plater-Zyberk, town planners and co-authors of the recently published *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*, sprawl has five key physical components: a preponderance of single-family housing subdivisions; retail and entertainment functions arranged in strip centers and shopping malls; office parks; decentralized civic institutions such as schools, churches, and community centers; and a far-flung road and highway network that links them together. Like most critics of sprawl, Duany and Plater-Zyberk advanced several solutions: zoning that allows — or requires — higher density; mixed-use development; restrictions on automobile use or policies that encourage the use of mass transit; street design that encourages walking; limits on the development of new land; and regional government to enforce these measures.

These solutions imply drastic changes in local jurisdictional powers, as well as in taxation, zoning, and individuals' property rights. Yes, advocates reply, but since fighting sprawl is like combating a spreading

cancer — the metaphor is common — it calls for drastic measures. But before diseases can be treated they must be diagnosed. Which type of cancer is it? How far has it progressed? Is it in an early stage or is it advanced? Does one prescribe a low-fat diet and exercise, or rush the patient to the operating room?

POPULATION DENSITY

The simplest measure of how much a metropolitan area sprawls is its population density — that is, the number of inhabitants per square mile. Table I shows the 15 largest metropolitan areas in the United States ranked by population density. The “gross” density is based on the total population of the Consolidated Metropolitan Statistical Area (CMSA), or of the Metropolitan Statistical Area (MSA), divided by its area. The “net” density is the density of the CMSA (or MSA) exclusive of cities with populations greater than 100,000, reflecting the fact that sprawl is generally considered to take place outside the city — or cities, in the case of a CMSA. The differences between gross and net densities are most striking in the cases of New York, Chicago, and San Francisco, which have dense cities compared to their surrounding regions, and in Houston, Dallas and Phoenix, which do not have

Table I 15 Largest Metropolitan Areas Ranked by Density, Persons/Sq. Mile
(U.S. Census Bureau, 2000)

	Gross	Net	Difference
New York–Northern NJ–Long Island, N.Y., N.J., Conn., Pa. CMSA	2,086	1,353	35%
Chicago–Gary–Kenosha, Ill., Ind., Wisc. CMSA	1,321	939	29%
Miami–Fort Lauderdale, Fla. CMSA	1,229	1,087	12%
Philadelphia–Wilmington–Atlantic City, Pa, N.J., Del., Md. CMSA	1,043	822	21%
San Francisco–Oakland–San Jose, Calif. CMSA	922	687	25%
Boston–Worcester–Lawrence, Mass., N.H., Maine, Conn. CMSA	902	801	11%
Detroit–Ann Arbor–Flint, Mich. CMSA	831	668	20%
Washington–Baltimore, D.C., Md., Va., W. Va. CMSA	794	684	14%
Atlanta, Ga. MSA	671	619	8%
Houston–Galveston–Brazoria, Texas CMSA	606	394	35%
Dallas–Fort Worth, Texas CMSA	574	430	25%
Seattle–Tacoma–Bremerton, Wash. CMSA	492	400	19%
Minneapolis–St. Paul, Minn., Wisc. MSA	490	396	19%
Los Angeles–Riverside–Orange County, Calif. CMSA	482	373	23%
Phoenix–Mesa, Ariz. MSA	223	119	47%

dense cities but whose surrounding regions have comparatively low densities.

Consistent with intuition, Table I reveals that the metropolitan areas of New York, Chicago, Miami, and Philadelphia sprawl the least, while Phoenix, Los Angeles, Minneapolis, and Seattle sprawl the most. The range of densities is large: the densest metropolitan area is ten times denser than the least dense. This range parallels the difference in the density of the prime cities (Table II). For example, the density of the city of Philadelphia is 10,493 persons/sq.mile and the density of

metropolitan Philadelphia is 1,043 persons/sq.mile; the density of the city of Phoenix, on the other hand — which has almost the same population as the city of Philadelphia — is only 2,885 persons/sq.mile, and the density of metropolitan Phoenix is correspondingly less: 223 persons/sq.mile. On the whole, it appears that high-density cities are surrounded by correspondingly high-density metropolitan areas, and low-density cities are surrounded by low-density (i.e., sprawling) metropolitan areas. This density ranking also supports a popular image of sprawl: that

Table II Prime Cities of the 15 Largest Metropolitan Areas Ranked by Density, Persons/Sq. Mile
(U.S. Census Bureau, 1999 est.)

New York City	24,039
San Francisco	15,991
Chicago	12,320
Boston	11,472
Philadelphia	10,493
Miami	10,372
Washington, D.C.	8,453
Los Angeles	7,743
Detroit	6,958
Minneapolis	6,437
Seattle	6,402
Houston	3,419
Dallas	3,143
Atlanta	3,048
Phoenix	2,885

the newer Sunbelt urban areas, like their cities, sprawl more than the older Rustbelt urban areas. The striking exception is the metro area of Sunbelt Miami, which is denser than Rustbelt Philadelphia.

Table I supports the common image of sprawl, but metropolitan density, while easy to compute, is a misleading measure of sprawl. For example, an apparently low-density metropolitan area might simply have large amounts of unbuildable land — mountain slopes or wetlands. Or, it might have aggressively annexed rural areas, or created land banks or nature preserves. Thus a metropolitan area with high-density concentrations of population separated by unbuilt open spaces could appear to be less dense than an area that is saturated with low-density development. Nor

does population density take into account commercial and retail densities; whether people work in office towers or office parks; whether they shop on Main Street or in strip malls.

URBANIZED DENSITY

A more accurate picture of metropolitan population density requires measuring only the land that is actually urbanized. The U.S. Department of Agriculture conducts a survey every five years — the National Resources Inventory (NRI) — that estimates the amount of urbanized land in each county. The NRI defines urbanized land to include residential, industrial, commercial, and institutional

land, as well as airports, railroad yards, golf courses, and sanitary landfill sites. In research published by the Brookings Institution, William Fulton, Rolf Pendall, and researchers at the Solimar Research Group calculated metropolitan densities based on 1997 NRI data. The results for the 15 largest metropolitan areas are shown in Table III.

The ranking in Table III is radically different from Table I. Metropolitan Los Angeles, which appeared to be a low-density area in Table I, is the densest metro area of the 15 on the list. The Phoenix MSA, which ranked dead last with a density of 223 persons/sq.mile, has a much higher density of 4,608 persons/urbanized sq.mile, and ranks fifth in the country.

(Both metropolitan areas contain mountainous areas and large tracts of parkland.) On the other hand, metropolitan Philadelphia, which was number four in Table I and seemed to be an example of a relatively non-sprawling metropolitan area, is ranked number ten in Table III, below San Francisco, Washington, D.C., Boston, and Seattle, as well as Phoenix and Los Angeles.

Measuring *urbanized* density turns conventional wisdom on its head. Metropolitan Los Angeles and Phoenix are not sprawling but relatively dense; so is San Francisco (despite the apparent sprawl of Silicon Valley and San Jose). And the metro areas of “old” Philadelphia and Detroit are less dense than “new” Seattle

Table III 15 Largest Metropolitan Areas Ranked by Persons/Urbanized Square Mile
(U.S. National Resources Inventory, U.S. Census Bureau, 1997)

Los Angeles–Riverside–Orange County, Calif. CMSA	5,318
New York–Northern NJ–Long Island, N.Y., N.J., Conn., Pa. CMSA	5,114
San Francisco–Oakland–San Jose, Calif. CMSA	5,094
Miami–Fort Lauderdale, Fla. CMSA	5,075
Phoenix–Mesa, Ariz. MSA	4,608
Chicago–Gary–Kenosha, Ill., Ind., Wisc. CMSA	3,853
Washington–Baltimore, D.C., Md., Va., W. Va. CMSA	3,763
Boston–Worcester–Lawrence, Mass., N.H., Maine, Conn. CMSA	3,616
Seattle–Tacoma–Bremerton, Wash. CMSA	3,264
Philadelphia–Wilmington–Atlantic City, Pa., N.J., Del., Md. CMSA	3,219
Detroit–Ann Arbor–Flint, Mich. CMSA	2,733
Minneapolis–St. Paul, Minn., Wisc. MSA	2,464
Dallas–Fort Worth, Texas CMSA	2,419
Houston–Galveston–Brazoria, Texas CMSA	2,221
Atlanta, Ga. MSA	1,818

and Phoenix. On the other hand, some common perceptions are upheld: Dallas and Houston *do* have low densities, and Atlanta, the poster child for sprawl, *does* have a significantly lower density than other large metropolitan areas.

There is another striking difference between gross population density and urbanized density. In Table I, the ranking roughly breaks down into three unequal groups: the most dense metro area, New York, is in a class by itself; next are five older metro areas of the Northeast and the Midwest, plus San Francisco and Miami; the least dense group of seven metro areas are mostly in the Sunbelt and West. In Table III, the ranking breaks down into three equal groups: the most dense consists

of four Sunbelt and Western metro areas plus New York; next are three Rustbelt areas plus Seattle and Washington, D.C.; the least dense are three Sunbelt metro areas plus two Rustbelt areas. In other words, low-density development is not uniquely a phenomenon of the South and West; on the contrary, four of the five densest metropolitan areas in the country are in the South and West. When urbanized land is taken into account, not only is the ranking more evenly distributed, the spread between the most dense and the least dense is considerably lessened, from 9:1 to 3:1.

Stephen Malpezzi of the University of Wisconsin has found that the density of census tracts containing the 10th per-

Table IV 15 Largest Metropolitan Areas Ranked by Density of Tract Containing 10th Percentile HH, Tracts Sorted by Density, Persons/Square Mile (Malpezzi, 1999)

New York, N.Y. PMSA	2,173
Los Angeles–Long Beach, Calif. PMSA	1,053
Miami–Hialeah, Fla. PMSA	829
Chicago, Ill. PMSA	748
San Francisco, Calif. PMSA	644
Phoenix, Ariz. MSA	341
Boston, Mass. PMSA	227
Philadelphia, Pa., N.J. PMSA	206
Seattle, Wash. PMSA	184
Washington, D.C., Md., Va. PMSA	183
Houston, Texas PMSA	162
Detroit, Mich. PMSA	157
Dallas, Texas PMSA	146
Atlanta, Ga. MSA	86
Minneapolis–St. Paul, Minn., Wisc. MSA	64

centile of urban population by density is a good proxy for sprawl since it is highly correlated to other measures. The ranking of the 15 largest metropolitan areas is shown in Table IV. The precise ranking generally supports the ranking by urbanized densities of Table III; the differences are probably the result of using primary metropolitan statistical areas (PMSAs) rather than CMSAs for many of the areas, and of using census tracts, which reflect residential density and do not measure commercial and retail densities.

**CENTRALIZATION
OF EMPLOYMENT**

A different way of measuring sprawl has been suggested by Matthew E. Kahn of Tufts University. He assumes that the more a metropolitan area's employment is located beyond a 10-mile inner ring around the central business district, the higher is the level of sprawl. Table V ranks the 15 met-

ropolitan areas according to the percentage of a metropolitan area's jobs that are located outside the 10-mile ring (an area of about 300 sq. miles). The metropolitan area here is defined not as the CMSA or MSA, but rather as a 35-mile outer ring around the central business district (an area of about 3,500 sq. miles).

The ranking in Table V shows a wide divergence, from a low of 23.2 percent in New York City to a high of 78.6 percent in Detroit. Nevertheless, in general, the ranking in Table V conforms to Table III; that is, New York City, Miami, San Francisco, and Phoenix have high urbanized densities and high centralization of employment, whereas Detroit, Atlanta, Philadelphia, Dallas, and Houston have low urbanized densities and low centralization of employment. There are anomalies, however; notably Los Angeles and Chicago, which have low centralization of employment accompanied by high urbanized densities, and Minneapolis, which has high centralization of employment and a low urban-

Table V 15 Largest Metropolitan Areas Ranked by Percentage of Jobs Outside a 10-mile Ring
(U.S. National Resources Inventory, U.S. Census Bureau, 1997)

New York City	23.2	Houston	50.9
Miami	37.6	Dallas	58.8
Minneapolis	38.6	Philadelphia	61.1
San Francisco	38.8	Los Angeles	62.8
Phoenix	42.5	Chicago	63.6
Boston	44.8	Atlanta	64.7
Seattle	45.2	Detroit	78.6
Washington, D.C.	47.2		

ized density. It appears that in Los Angeles and Chicago, a spread of jobs across the metropolitan region has not produced low-density development, whereas in Minneapolis, low-density development has occurred despite employment being concentrated in the inner ring. It may be that the centralization of employment in a metropolitan area is not an accurate proxy for sprawl, after all.

S P R A W L O V E R T I M E

Urban growth is a dynamic process, so assuming that sprawl can be measured at a single point in time can be misleading. For example, scattered development is often associated with sprawl, yet if the interme-

diated undeveloped land is subsequently developed, sprawl disappears. In such a case, low-density development may be simply an intermediate stage in the urban growth process. Is this sprawl, or is it merely a stage in the urbanization process?

The relationship between the increase in urbanized land area (A) and the increase in metropolitan population (P) — measured in percentages — for a given period measures whether a metropolitan area became more — or less — dense. If A/P is less than 1, then the area has densified; if it is greater than 1, then it is becoming less dense. The 15 largest metropolitan areas are ranked by the A/P index for 1982–97 (Table VI).

The six metropolitan areas at the bottom of the list increased their urbanized

Table VI 15 Largest Metropolitan Areas Ranked by A/P Index, 1982–97
(U.S. National Resources Inventory, U.S. Census Bureau, 1997)

Phoenix–Mesa, Ariz. MSA	0.57
Los Angeles–Riverside–Orange County, Calif. CMSA	0.88
Miami–Fort Lauderdale, Fla. CMSA	0.89
Dallas–Fort Worth, Texas CMSA	1.11
San Francisco–Oakland–San Jose, Calif. CMSA	1.22
Atlanta, Ga. MSA	1.34
Houston–Galveston–Brazoria, Texas CMSA	1.45
Seattle–Tacoma–Bremerton, Wash. CMSA	1.54
Washington–Baltimore, D.C., Md., Va., W. Va. CMSA	1.58
Minneapolis–St. Paul, Minn., Wisc. MSA	2.43
Chicago–Gary–Kenosha, Ill., Ind., Wisc. CMSA	2.66
New York–Northern NJ–Long Island, N.Y., N.J., Conn., Pa. CMSA	3.36
Philadelphia–Wilmington–Atlantic City, Pa., N.J., Del., Md. CMSA	5.09
Detroit–Ann Arbor–Flint, Mich. CMSA	5.80
Boston–Worcester–Lawrence, Mass., N.H., Maine., Conn. CMSA	7.00

areas more than twice as quickly as they increased their populations. It is striking that these six areas are precisely the old manufacturing cities of the Northeast and Midwest. Except for the Minneapolis MSA, these older metropolitan areas had single digit growth during the 1982–97 period. Thus sprawl may be less a function of growth than of historic conditions — that is, in a region with an old, dense center city, peripheral growth tends to take place at lower densities.

The converse also appears to be true. The top eight metropolitan areas in the ranking are Western and Sunbelt cities that experienced double-digit population growth during the 1982–87 period; the Atlanta and Phoenix MSAs increased their populations by more than 50 percent. Interestingly, Table VI is the only one in which the Atlanta CMSA is not at or near the bottom of the list; while Atlanta expanded faster than its population growth, it did so at a much slower rate than most metropolitan areas. So we have a situation where the faster-growing cities appear to be sprawling less than the cities with little population growth.

CONCLUSION

The metropolitan areas that have tended to consume the most land are in the Northeast and Midwest. It seems likely

that because land around slow-growing Eastern and Midwestern metropolitan areas was cheaper, new development has been more sprawling. It is also possible that in already dense metropolitan areas there is a greater demand for low-density development, and therefore more sprawl. On the other hand, the metropolitan areas that have tended to consume less land for urbanization (relative to population growth) are in the West and South. Perhaps because land in these fast-growing metropolitan areas was more expensive (and in the West and Southwest constrained by geography and water availability), 10 of the 15 densest metropolitan areas in the United States were in California, Nevada, and Arizona. The studies indicate that these states generally have some of the densest metropolitan areas in the country, yet it is here that people complain most about sprawl, which suggests that fast growth, rather than sprawl, may be the real focus of the public's concern.

The various measures of sprawl described in this paper challenge the conventional wisdom. First, the density of metropolitan development is not necessarily a function of whether an area is “new” or “old,” or whether it is in the South and West, or in the Northeast. Moreover, some of the newer metro areas, such as Los Angeles and Phoenix, actually have higher population densities than older metro areas

such as Chicago and Boston. There is also evidence that many metropolitan areas in the South and West — even the least dense areas such as Atlanta, Dallas, and Houston — are becoming denser. On the other hand, some older metro areas are sprawling more. Two of the older metro areas — Philadelphia and Detroit — rank as extreme examples of low-density development according to several measures.

If one excludes Atlanta, the range between the least dense metro area (Houston, with 2,221 persons/urbanized sq. mile) and the most dense (Los Angeles, with 5,318 persons/urbanized sq. mile) is not great. Given the varying age, size, history, and geographic location of different metropolitan areas, the density of contemporary urban development is remarkably consistent.

Generally, metropolitan areas have grown by becoming less dense, reflecting national trends. According to a 2000 Government Accounting Office study, between 1970 and 1990 the total population of U.S. metropolitan areas grew by 31 percent, while the amount of developed land in these areas grew by 75 percent, a multiplier of 2.4. Of the 281 metropolitan areas studied by Fulton and Pendall, only 17 became more dense during the same period. Overall, between 1982 and 1997, the population of the United States grew by 17 percent, but the amount of urbanized land increased by 47 percent, a multiplier of 2.7.

Is this cause for alarm? Urbanization is equated with economic growth, but there is no rule that more urbanization equals more densification; on the contrary, the opposite may be true. A community that survives by subsistence farming, for example, has minimum resources: small dwellings, a few animal shelters, minimal capacity for food storage. As the economy prospers, houses become larger; so do food storage facilities. Civic buildings are added; so are recreational facilities. Life becomes richer, more complicated: the same community now occupies more space. For decades, the social concern has been overcrowding and its costs; now that problem has been solved, we complain about sprawl.